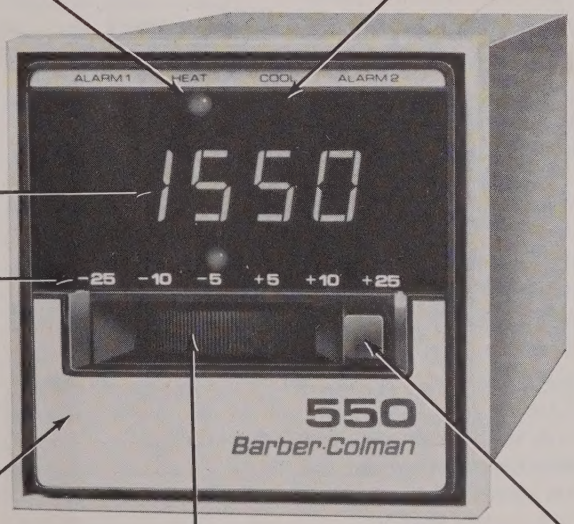
1252/IN 500-2

550 Series
Controllers

INSTRUCTION MANUAL

Volume 1. Installation, Wiring, and Operation



HEAT Light:
Glows to indicate current outputs is ON. Flashes to show cycling of triac and relay outputs. Glows to indicate CCW output for Actuator

COOL Light:
Glows to indicate cycling of triac and relay outputs. Glows to indicate CW output for Actuator Controller.

Displays either Process Temperature, Setpoint Temperature, or Control Adjustment.

Deviation Scale LED'S

Control Access Door

Setpoint Dial, 10 turns which is equivalent to a 62" long scale.

Setpoint Dial Lock:
Depress to release setpoint dial and display setpoint. Setpoint setable ± 1 degree.

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1. DESCRIPTION

The 550 is a microprocessor directed industrial process controller. It accepts signals directly from the thermocouples listed in the model code in Section 3. You can change the ranges by moving a jumper.

Either a single or a dual alarm can be ordered. You can change to any one of the Alarm Modes listed in the model code in Section 3 by moving a jumper.

The FOUR CONTROL MODES are standard and included in all 550 Controllers. The microcomputer in each is programmed for P.I.D. control. Control Modes include: On-Off, Proportional, Proportional plus Integral (Reset), and Proportional plus Integral plus Derivative (Rate).

ON-OFF control operation switches the load only at setpoint. The On-Off mode is selected with a block jumper on the Display Driver circuit board.

GAIN (Proportional Band) and Cycle Time can be changed for proper time proportioning control.

INTEGRAL (Reset) action is adjustable to prevent offset (droop) in processes where severe and frequent load changes occur.

Reset Windup Inhibition is included with the Integral control mode to limit overshoot by inhibiting reset action during process warmup. Reset Windup Inhibition is particularly desirable for processes where large step changes are likely to occur.

DERIVATIVE (Rate) action is suitable for processes where sudden upsets, appreciable transfer lag, or a small to moderate amount of dead time is present. Derivative action corrects the controller output proportional to the rate of change of a deviation.

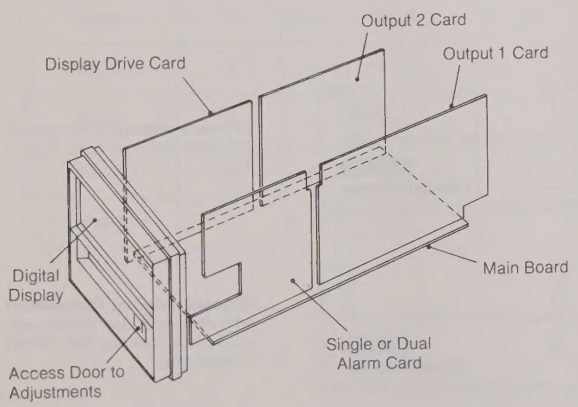


Figure 1-1. Relation of Circuit Cards

2. SPECIFICATIONS

2.1 Control Adjustment Specifications

GAIN (Proportional Band)

For all instruments except single ON-OFF output controllers, Gain is adjustable from 1 to 100 (proportional band from 100% of span to 1% of span). The adjustment potentiometer is located under the access door. When the instrument is being set up, the value for Gain can be displayed on the Digital Readout.

RESET (Integral)

For all instruments except single ON-OFF output controllers. Reset is adjustable from 0 to 6.00 repeats per minute. The adjustment potentiometer is located under the access door. When the instrument is being set up, the value for Reset can be displayed on the Digital Readout (two-decimal places).

RATE (Derivative)

All instruments except single ON-OFF output controllers. Rate time is jumper selectable to OFF, 0.05, 0.1, 0.5, or 1.0 minute. The block jumper for Rate is located on the Display Driver circuit card with the Rate time clearly labeled.

Gain Ratio: On dual output time proportioning models, the gain for Output 2 (cooling) can be adjusted without affecting Output 1 (heating). The gain of Output 1 divided by the gain of Output 2 is the Gain Ratio. Range of Gain Ratio adjustment is 1:1 (CCW) to 50:1 (CW). The Gain Ratio potentiometer is located under the access door. Normally, Gain Ratio is factory set at 10:1

Spread: On dual output models where Output 2 is ON-OFF, separation of control action between Output 1 and Output 2 is achieved by the Spread Adjustments. The range of SPREAD COARSE (marked GAIN RATIO) is setpoint temperature ± 145°. SPREAD FINE (marked DEADBAND) provides improved setability within this range. Spread Adjustments are located under the access door. The Digital Readout will indicate the actual temperature where Output 2 energizes.

Spread between Outputs is fixed until re-adjusted, but changing instrument Setpoint moves the switching points of both outputs equally.

Deadband: On dual output time proportioning models, the amount of separation between the outputs is adjustable from 0 to 20 degrees. The Deadband potentiometer is located under the access door. Deadband is factory adjusted CCW at 0 degrees.

Setpoint Limit: The SETPOINT LIMIT Adjustment limits the maximum setpoint of the range from the top of the purchased span (fully CW) down to 1/4 of the way from the bottom of the span (fully CCW).

Cooling Limit: On dual output models where Output 2 is a Time Proportioning Triac, Cooling Limit is continuously adjustable from 0 to 100% ON time. The Cooling Limit potentiometer is located on the Output 2 (Time Proportioning Triac) card and is clearly labeled 0-100.

2.2 Input Specifications

The Series 550 is programmed for all the ranges shown in the model code in Section 3.

You can change to any one of the ranges by moving a jumper.

Thermocouple Break Action: Upscale only. Digital Readout displays "HI" if a thermocouple break occurs.

Cold Junction Compensation: Externally mounted BALCO Cold Junction Compensation resistor improves tracking and performance.

Source Resistance: Total resistance of thermocouple and thermocouple extension leadwire can be up to 200 ohms.

Input Reference: The sensor input can be referenced to ground or can be floating.

Common Mode Rejection (CMR): 140 decibels
Maximum Common Mode Voltage: 120 Vac r.m.s.

Series Mode Rejection (SMR): 60 decibels.
Maximum Series Mode Voltage: 200 mV or 5 times span.

2.3 Indicator Specifications

Listed in Section 13, Display Despription

2.4 Display Specifications

Listed in Section 13, Display Description

2.5 Output Specifications

Listed in Section 8, Output Wiring

2.6 Alarm Specifications

Listed in Section 10, Alarm(s) Operation

2.7 General Specifications

REFERENCE ACCURACY

0.1% of span or 1°C, whichever is greater; plus, conformal error of 0.2% span or 2.°C, whichever is greater.

REFERENCE OPERATING CONDITIONS

Ambient Temperature: 25°C ± 2°C (77°F ± 3.6°F).
Line Voltage: 120 or 250 Vac, ± 1%, 60 Hz.
Relative Humidity: 0 to 50% RH.

RATED ACCURACY

± (0.5% of span +2°C).

RATED OPERATING CONDITIONS

Ambient Temperature: 0° to 55°C (32° to 130°F).
Line Voltage: 120 or 240 Vac, +10%-15%, 60 Hz; 110 or 220 Vac, ± 10%, 50 Hz.
Relative Humidity: 0 to 70% RH.

MOUNTING POSITION (Tilt)

The 550 controller can be panel mounted in any position.

STORING TEMPERATURE

-40°C to +70°C (-40° to 158°F).

SAMPLING TIME

2 samples per second. The 550 controller responds to an input change or process disturbance 2 times each second.

LINE VOLTAGE STABILITY

±10%, -15% change in line voltage from nominal will not shift the control point more than 0.05% of span. This error is included in the accuracy ratings.

TEMPERATURE STABILITY

6 microvolts per °C maximum; 3 microvolts per °C typical. A change in ambient temperature can cause a shift in the displayed temperature on the Digital Readout.

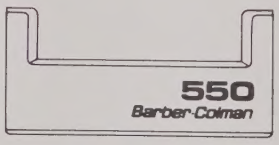
The maximum shift in the displayed temperature is 2°C over the rated ambient temperature of 0 to 55°C.

POWER CONSUMPTION 10 VA

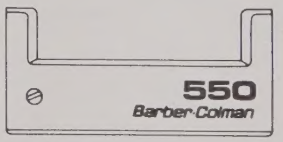
Shipping Weight: 1.8 kg (4 lbs.), with housing.

Access Door

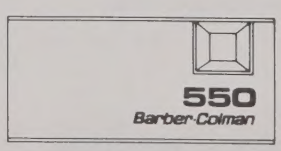
To discourage tampering, control adjustments are concealed beneath a magnetically latched access door. The access door is hinged at the bottom and can be opened by pulling forward with your fingertips at the top left or right of the access door.



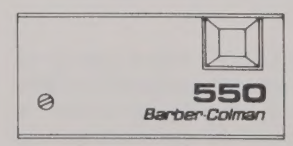
Exposed setpoint (door code 0) provides easy setpoint adjustment.



Exposed setpoint thumbwheel with door lock (door code 2) discourages tampering with control adjustments.



Concealed setpoint thumbwheel (door code 1) discourages tampering with setpoint.



Concealed setpoint thumbwheel with door lock (door code 3) discourages tampering with setpoint and control adjustments.

Figure 1-2. Four Styles of Access Doors

3. MODEL NUMBER CODE ORDERING INFORMATION

WRITE THE ENTIRE 15-DIGIT CODE
IN THE BLOCKS WHEN ORDERING

55 □ □ - 0 □ □ □ □ - 0 □ □ - □ - □ □

OUTPUT #1
1 = ON-OFF Triac
2 = ON-OFF Relay
5 = Time Proportioning Triac
6 = Time Proportioning Relay
7 = Current, 2-12 mA
8 = Current, 4-20 mA
9 = Actuator Positioning with Feedback Slidewire

OUTPUT 2
A = None
B = ON-OFF Relay*
C = Time Proportioning Triac**
9 = Actuator Positioning with Feedback Slidewire ****

RANGE CODE

Range Codes	TC Type	Range
4540	J	-100 to 1500°F
4543	J	-100 to 800°C
0031	K	0 to 2500°F
4544	K	0 to 1350°C
4541	R	0 to 3100°F
4545	R	0 to 1700°C
4542	S	0 to 3100°F
4546	S	0 to 1700°C

SPECIALS
00 = None
Consult Factory for All Specials

ALARM(S)

Single
0 = None (Standard)
1 = Deviation
2 = Deviation Band
3 = Process

Dual
4 = Deviation and Deviation
5 = Band and Band
6 = Process and Process
7 = Deviation and Band
8 = Deviation and Process
9 = Band and Process

Alarm Options

Option	Alarm 1	Alarm 2
0	None	None
1	Deviation	None
2	Deviation Band	None
3	Process	None
4	Deviation	Deviation
5	Band	Band
6	Process	Process
7	Deviation	Band
8	Deviation	Process
9	Band	Process

HOUSING
0 = Panelmount (Standard)
1 = Shipped without housing. Order housing separately.

ACCESS DOOR
0 = Exposed Setpoint
1 = Concealed Setpoint
2 = Exposed Setpoint w/Lock
3 = Concealed Setpoint w/Lock

Any range can be selected by means of a jumper on the Main Board. The front panel SETPOINT LIMIT Adjustment can be used to limit the range over which you can place the setpoint.

* Not available with ON-OFF Relay or Time Proportioning Relay at Output 1.
**Not available with ON-OFF Triac or ON-OFF Relay at Output 1.
***Order with Output 2, Option 9.
****Available only with Output 1, Option 9.

4. MOUNTING

The Series 550 Controller can be mounted in any position. Dimensions are guaranteed only if Certified Drawing 1252 DR7 is ordered.

After the panel cutout is made, install the controller as follows:

1. Loosen the two fasteners on the mounting brackets enough to allow the brackets to retract below the surface of the housing.

   Do not completely remove the brackets.

2. Insert the housing through the panel and carefully tighten the mounting bracket fasteners until the housing is held firmly against the panel. Do not overtighten the mounting bracket.

Unless otherwise specified, all dimensions on Figure 4-1 are maximum.

Access Door opens 180° when unrestricted. Access Door opens 165° when instruments are mounted on 100mm (3.937") vertical spacing.

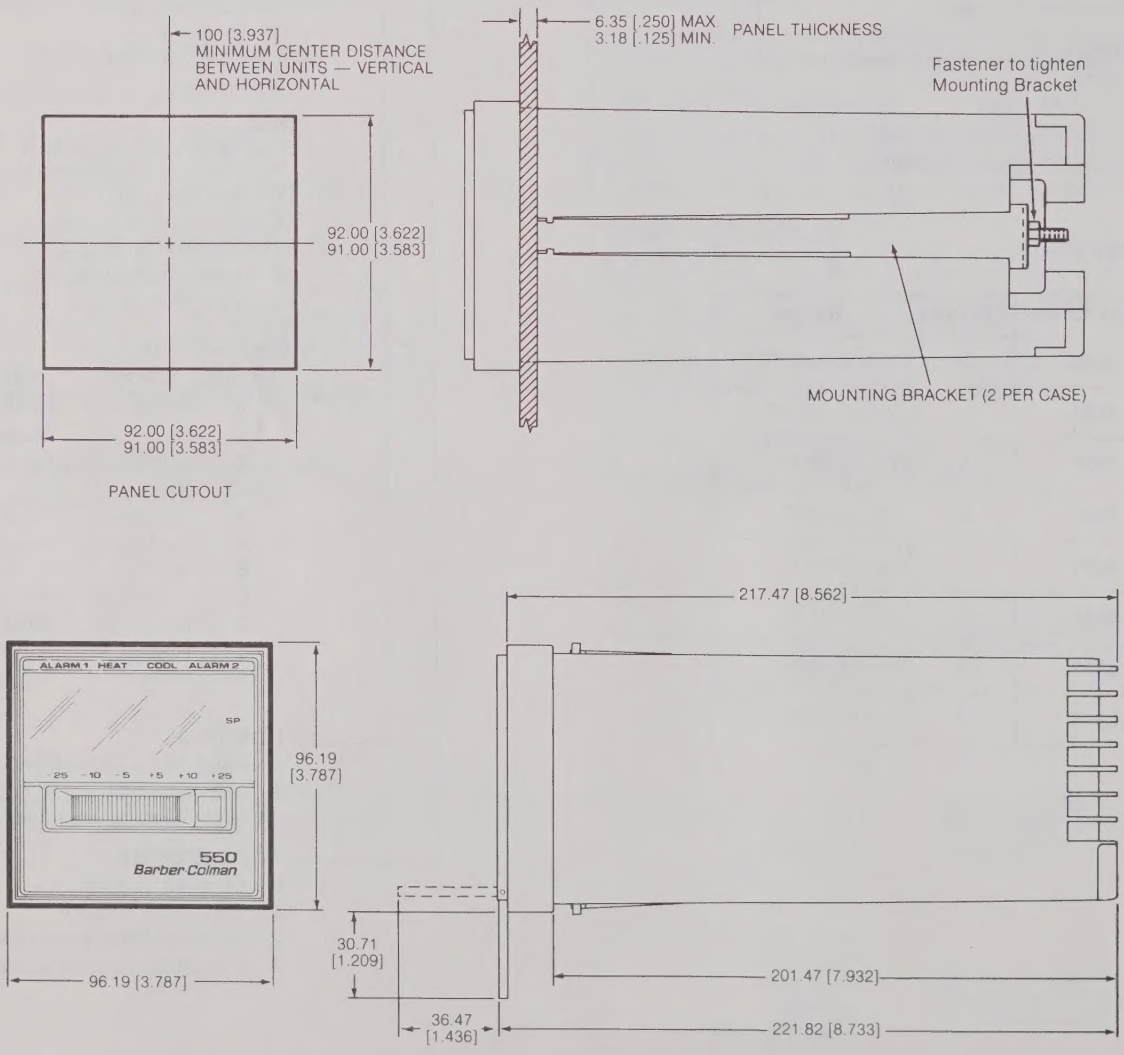


Figure 4-1. Mounting Dimensions

5. INSTALLATION AND REMOVAL OF CONTROLLER CHASSIS

5.1 Installation

To install the instrument chassis into the housing, proceed as follows:

1. Inspect the housing interior to make sure it is clean and free of obstructions.
2. Align the horizontal and vertical circuit cards into their guides.
3. Slide the chassis into the housing and press firmly to ensure a good electrical connection with the rear terminal contracts.
4. A quarter-turn fastener (screwdriver slotted) holds the instrument chassis to the housing. The OPEN-LOCK screw is located under the access door.
   Using a small screwdriver, turn the OPEN - LOCK screw approximately 1/4 turn clockwise (CW) to fasten the chassis to the housing.
5. Fold the wire handle down and close the door.

5.2 Removal

To remove the instrument chassis from its housing, proceed as follows:

1. Open the access door.
2. Using a small screwdriver, turn the OPEN - LOCK screw approximately 1/4 turn counterclockwise (CCW).
3. A fold-down pull handle is provided to remove the controller chassis from its housing. The handle is located under the access door.

   Pull firmly on the wire handle and guide the chassis out of the housing with the other hand.

6. POWER WIRING

Line voltage input is either 120 or 240 Vac +10% −15%, at 60 Hz; or 110 or 220 Vac ±10%, at 50 Hz. Load power can be obtained from a separate power source in phase with the instrument power supply.

Instrument power switch and instrument fuses are included for illustrative purposes only. Consult local codes and appropriate wiring standards.

Connect a good earth ground to terminal J.

7. INPUT WIRING

Cold Junction compensation is standard with all thermocouple ranges.

Total resistance of leadwire and thermocouple can be 0 to 200 ohms, .25% of full scale maximum shift with a 100 ohm source.

Do not place power wiring and thermocouple wiring in the same conduit or wiring trough. The wires from several thermocouples may be in the same conduit or wiring trough. Always take these precautions on input wires longer than 10 feet: Twist the input wires and also shield them to maintain the integrity of the input signal.

If shielded thermocouple leads are used, the shields must be insulated electrically and terminated at one location, preferably the ground terminal of the Controller.

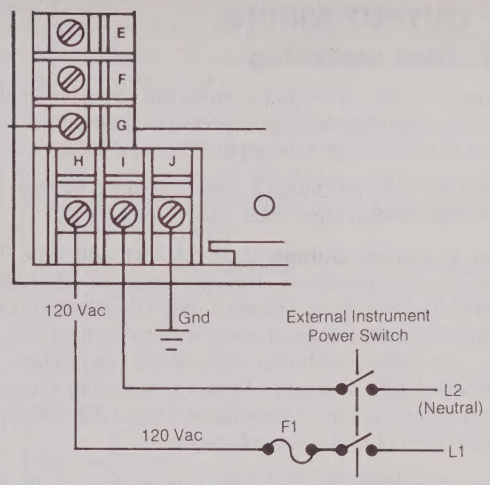


Figure 6-1. 120 Vac Power Supply Wiring

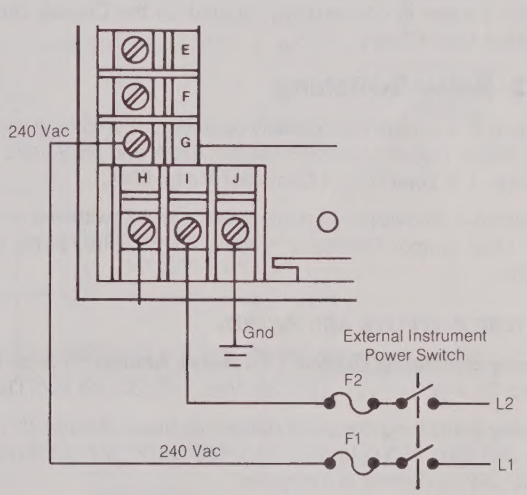


Figure 6-2. 240 Vac Power Supply Wiring

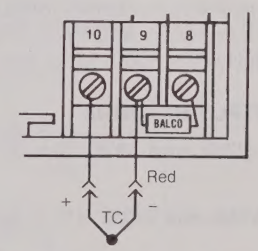


Figure 7-1. Thermocouple Input Wiring

When the Controller is ordered, the type of thermocouple desired is specified. The Barber-Colman Thermocouple Catalog lists a complete selection of thermocouple assemblies and thermocouple extension leadwire. Thermocouples should never be wired with ordinary copper wire. Wire only with thermocouple extension leadwire such as that specified in the Barber-Colman Catalog.

Observe the correct thermocouple and thermocouple extension wire polarity. The negative wire of both is usually coded red.

8. OUTPUT WIRING

8.1 Triac Switching

Figure 8-1. Shows the output switching wiring for Single Output Controller Models 551A and 555A, and for Output 1 of Dual Output Controller Models 551B, 555B, and 555C.

Figure 8-2. Shows Output 2 switching wiring for Dual Output Controller Models 555C, 556C, 557C, and 558C.

Triac Switching Output: (both ON-OFF and Time Proportioning): 1 A continuous, 140 mA minimum. 120/240 Vac, 125/250 VA Pilot Duty. The solid state Triac Switching Output of this Controller can switch any voltage from 24 Vac to 240 Vac. The voltage switched must be the same phase as the instrument power supply. Time Proportioning Output 1 is Reverse Acting. Time Proportioning Output 2 is Direct Acting. Typical On-Off hysteresis is 5 degrees.

Cycle Time: For time proportioning models, Cycle Time is jumper selectable to 1, 10, 20, or 40 seconds nominal. The block jumper is conveniently located on the Display Driver printed circuit board.

8.2 Relay Switching

Figure 8-3. Shows the normally open output switching wiring for Single Output Controller Models 552A and 556A, and for Output 1 of Dual Output Controller Model 556C.

Figure 8-4. Shows the normally open Output 2 switching wiring for Dual Output Controller Models 551B, 555B, 557B and 558B.

THESE OUTPUTS ARE RATED:

Relay Switching Output 1 (Reverse Acting): 5 A at 120 Vac, 2.5 A at 240 Vac. 120/240 Vac, 200/200 VA Pilot Duty.

Relay Switching Output 2 (Direct Acting): 2 A at 120 Vac, or 240 Vac. 120/240 Vac, 100/100 VA Pilot Duty. Typical ON-OFF hysteresis is 5 degrees.

8.3 Current Control

Figure 8-5. Shows the output control wiring for Single Output Controllers 557A and 558A, and for Output 1 of Dual Output Controllers Models 557B, 558B, 557C, and 558C.

CURRENT OUTPUT RATINGS:

Models 557A, 557B, and 557C: 2 to 12 mAdc into 1500 ohms or less.

Models 558A, 558B, and 558C: 4 to 20 mAdc into 750 ohms or less.

The current output on terminals A (negative) and C (positive) is short circuit proof and isolated. Either terminal can be grounded. Current output is reverse acting.

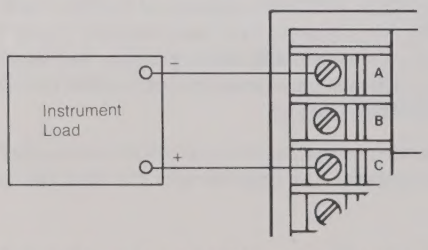


Figure 8-5. Output 1 Wiring, Current Output

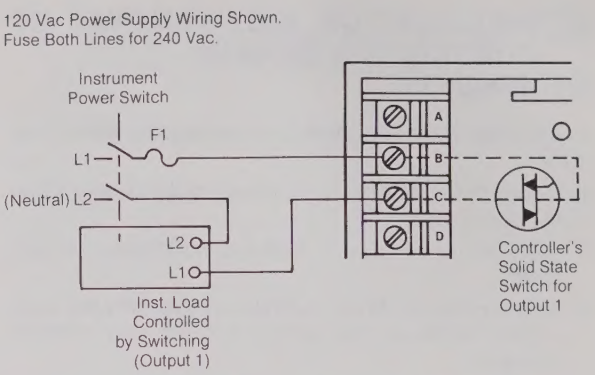


Figure 8-1. Output 1 Wiring, Triac Switching

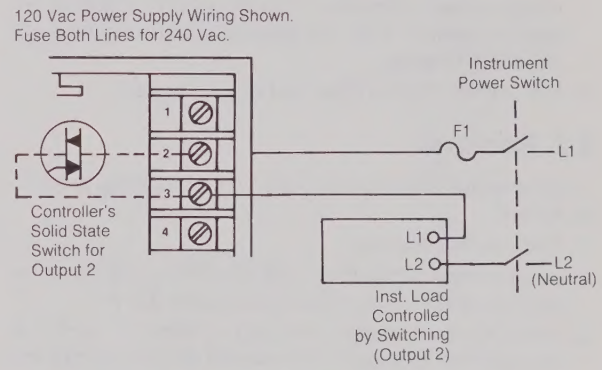


Figure 8-2. Output 2 Wiring, Triac Switching

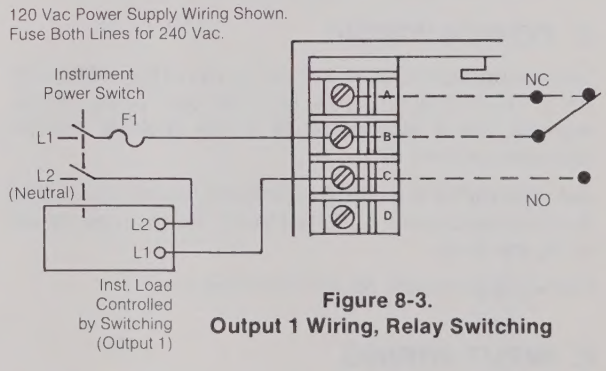


Figure 8-3.
Output 1 Wiring, Relay Switching

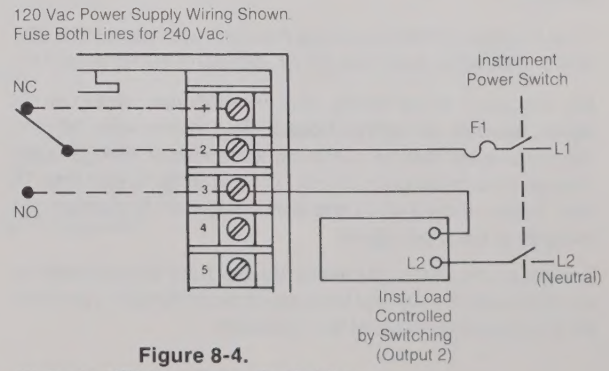


Figure 8-4.
Output 2 Wiring, Relay Switching

8.4 Electric Actuator Positioning, Proportional Output

See Figure 8-6. These Controllers have solid state Triac Switching Outputs:

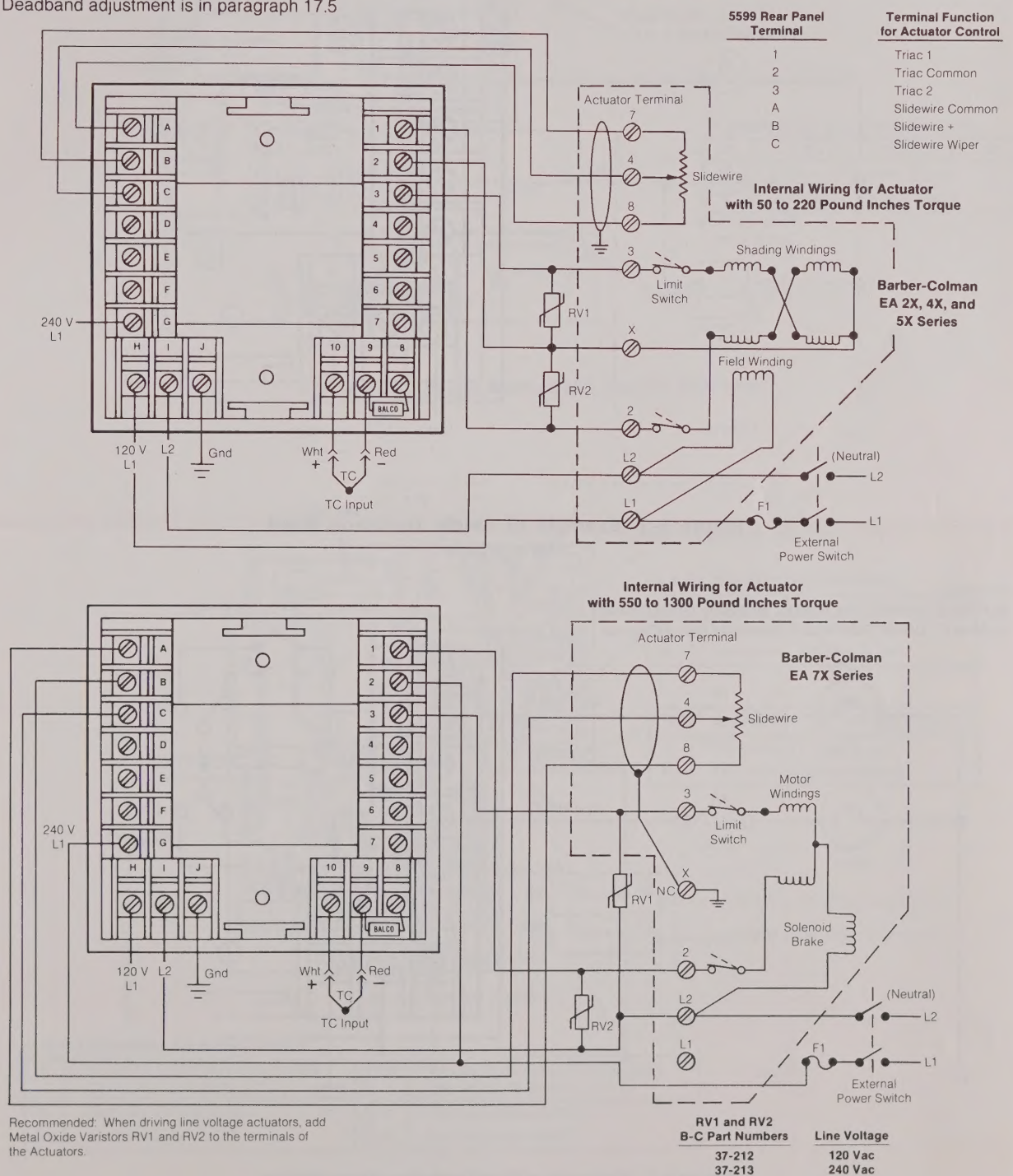
24/120/240 Vac, 36/180/360 VA Pilot Duty. 140 mAdc minimum.

A .5 Vdc excitation voltage is available for a 100 to 1000 ohm actuator feedback slidewire.

Deadband adjustment is in paragraph 17.5

For diagrams shown, 0% Output of Controller causes fully CW Actuator Rotation, and 100% Output of Controller causes fully CCW Actuator Rotation. To reverse this action interchange wires to Actuator Terminals 7 & 8 and 2 & 3.

Slidewire wiring must be run in a conduit separate from AC wiring. If this is not practical, use 3-conductor shielded cable. Ground the shield at the Actuator. **Do Not** ground the shield at the 550. Minumum conductor size is 22 gage for distances up to 100 feet. 18 gage over 100 feet.



Recommended: When driving line voltage actuators, add Metal Oxide Varistors RV1 and RV2 to the terminals of the Actuators.

RV1 and RV2 B-C Part Numbers	Line Voltage
37-212	120 Vac
37-213	240 Vac

Figure 8-6. Output Wiring for Electric Actuator Positioning Controllers

9. ALARM(S) WIRING

See Figures 9-1. and 9-2. Nominal alarm action hysteresis is 5°. Both Single and Dual Alarms are shipped with the alarm relay (s) energizing on an increasing signal.

NC means relay contacts are normally closed when alarm is de-energized.

NO means relay contacts are closed when alarm is energized.

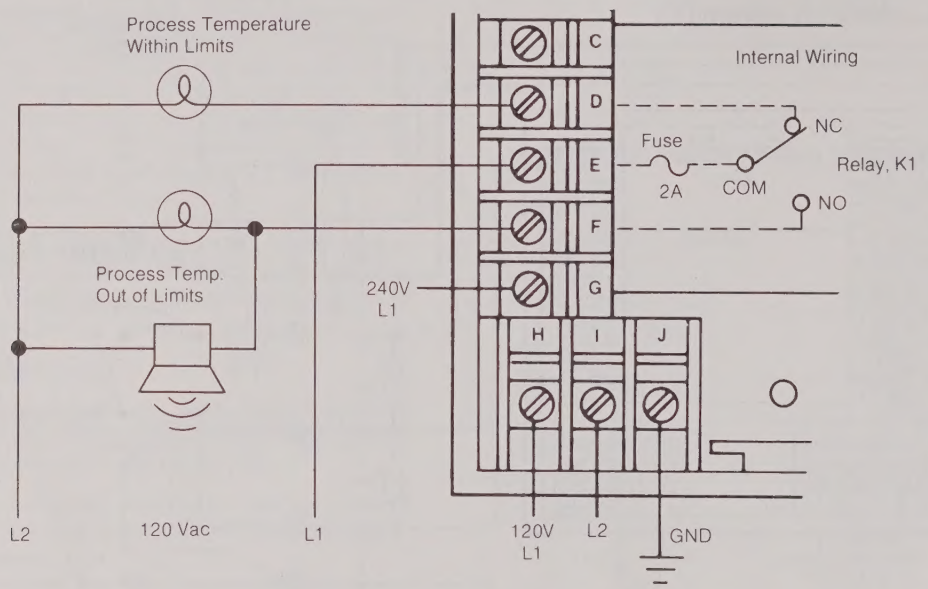


Figure 9-1. Example of Single Deviation Band Alarm Wiring

SHIPPED:
ALARM 1: DEVIATION MINUS, Normally Open Contact
ALARM 2: DEVIATION PLUS, Normally Open Contact

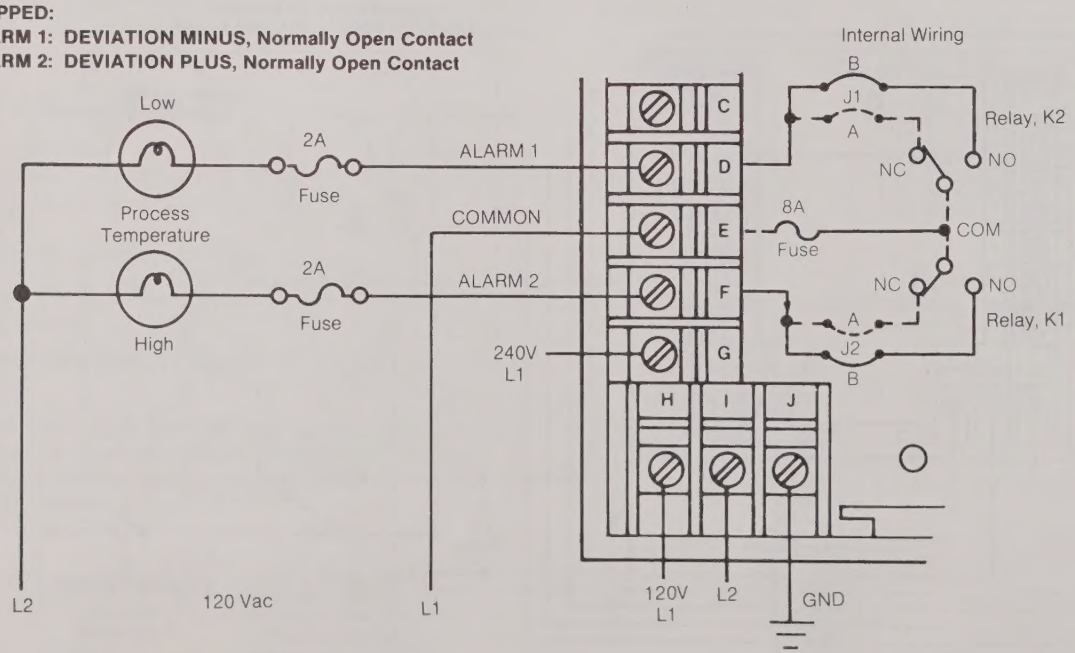
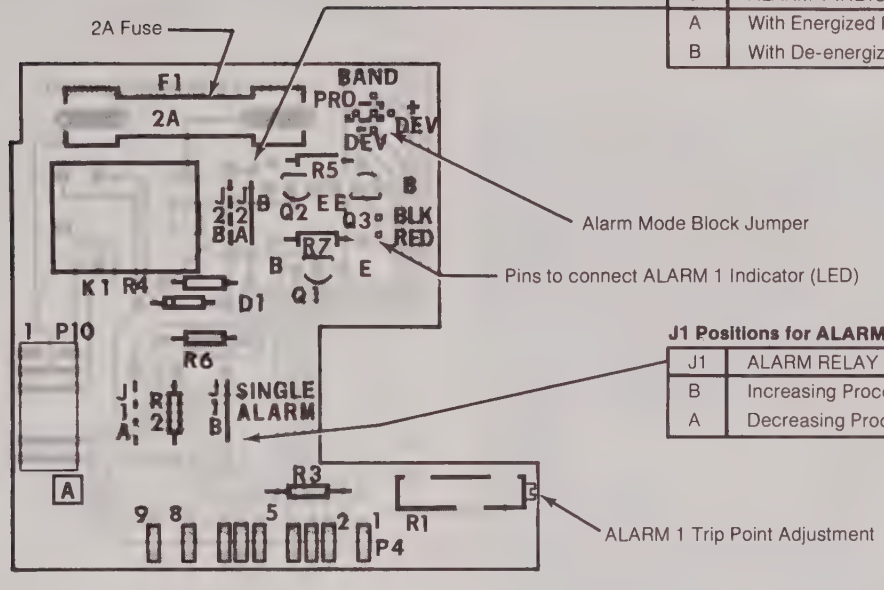


Figure 9-2. Example of Dual Deviation Alarm Wiring

J2 Positions for ALARM 1 Indicator Action

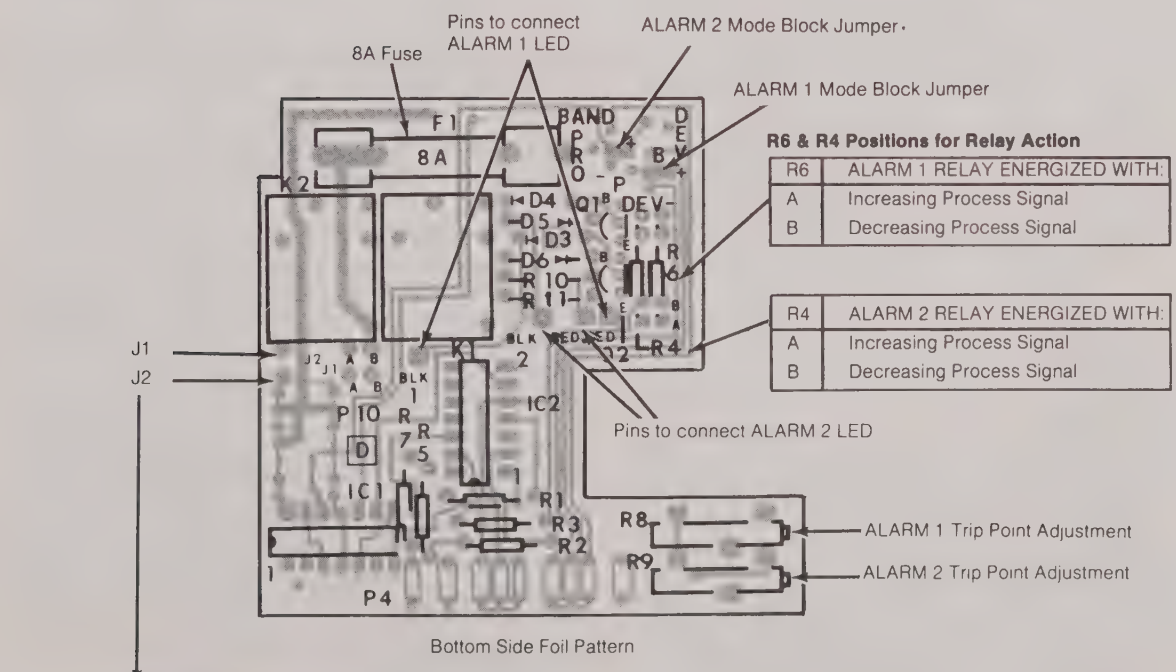
J2	ALARM 1 INDICATOR (LED) ON:
A	With Energized Relay
B	With De-energized Relay



J1 Positions for ALARM Relay Action

J1	ALARM RELAY ENERGIZED ON:
B	Increasing Process Signal
A	Decreasing Process Signal

Figure 10-1. Single Alarm Card Jumper Positions



R6 & R4 Positions for Relay Action

R6	ALARM 1 RELAY ENERGIZED WITH:
A	Increasing Process Signal
B	Decreasing Process Signal

R4	ALARM 2 RELAY ENERGIZED WITH:
A	Increasing Process Signal
B	Decreasing Process Signal

J1 and J2 Positions for Alarm Contact

J1	ALARM 1 CONTACT AVAILABLE ON REAR TERMINAL "D":
A	Normally Closed (N.C.)
B	Normally Open (N.O.)

J2	ALARM 2 CONTACT AVAILABLE ON REAR TERMINAL "F":
A	Normally Closed (N.C.)
B	Normally Open (N.O.)

Figure 10-2. Dual Alarm Card Jumper Positions

10. ALARM(S) SPECIFICATIONS, OPERATION AND JUMPER SELECTION

10.1 Alarm Specifications

ALARM(S)

Two independent alarms are available for Process, Deviation +, Deviation –, or Deviation Band in any combination. Selection of Alarm mode is conveniently field selectable by block jumpers on either the Single or Dual Alarm circuit board.

Single Alarm models are shipped with the alarm relay and alarm light (LED) energizing on an increasing signal. Alarm action can be reversed by re-positioning a soldered jumper on the Single Alarm circuit board.

Dual Alarm models are shipped with the alarm relay of both Alarm 1 and Alarm 2 energizing on an increasing signal. Relay action can be reversed by re-positioning a resistor for each Alarm on the Dual Alarm circuit board.

Alarm adjustment is located under the access door.

RANGE

Process: 0 to 100% of Span
Deviation: 0 to 500° from Setpoint
Deviation Band: 0 to 500° around Setpoint

Alarm 1 Contact Rating: 1 A at 120 Vac, resistive. Nominal alarm action hysteresis is 5 degrees. On single alarm models, the normally closed (NC) and normally open (NO) contacts are available on the rear terminals of the instrument case. Form C contacts.

Alarm 2 Contact Rating: 1 A at 120 Vac, resistive. Nominal alarm action hysteresis is 5 degrees. On Dual Alarm models, a soldered jumper on the alarm circuit card selects which contact (either NC or NO for each alarm) will be available on the rear terminals of the instrument case. Dual alarms share a COMMON terminal on the rear terminals. Form C contacts.

10.2 Operation

Alarm Setpoint Adjustment is described in Section 16, Setup.

PROCESS ALARM

This alarm actuates whenever the process signal exceeds the alarm setpoint. Changing the control setpoint does not affect the process alarm trip point.

DEVIATION ALARM

The Deviation Alarm actuates whenever the process value exceeds the controller setpoint by a predetermined (alarm setpoint) amount. Deviation Alarms can be field changed to operate on either an increasing or decreasing process signal. They are undirectional. When the controller setpoint is changed, the deviation alarm moves with it, maintaining the same deviation (+ or –) from setpoint.

DEVIATION BAND ALARM

Identical to Deviation Alarm, except it is bi-directional. A deviation of the process signal from control setpoint, exceeding the alarm setpoint value, in either a positive or negative direction, will trip the alarm relay.

Table 10-1. Relay Action

Alarm Type	Relay Action as Shipped
Process Alarm	Relay energizes above the Alarm Setpoint
Deviation Alarm	Relay energizes when the Alarm Setpoint is exceeded.
Deviation Band Alarm	Relay energizes when the Alarm Setpoint is exceeded in either direction from setpoint.

10.3 Alarm(s) Jumper Selection

All alarm circuits are on a single plug-in card located at the right front of the Controller.

The relay action shown in Table 10-1 can be changed. See Figures 10-1, and 10-2, page 11.

11. SETUP: CYCLE TIME, RATE, AND COOLING LIMIT, AND CURRENT CARD ACTION JUMPER SELECTION

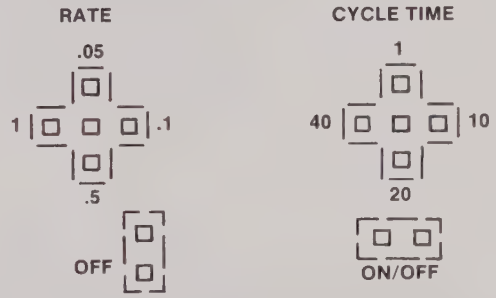


Figure 11-1. CYCLE TIME and RATE Jumper Selection on Display Drivers Card A-12330

11.1 Cycle Time Jumper

CYCLE TIME is in seconds and is only for controllers with a Time Proportioning Output(s). Either 1, 10, 20 or 40 seconds is jumper selectable. Move jumper to the ON-OFF storage position for all other models.

Table 11-1. CYCLE TIME Block Jumper Positions

Model Number	Position of CYCLE TIME Block Jumper as shipped from factory
555A	10 seconds
555B, 555C	20 seconds
556A	40 seconds
556C	40 seconds

11.2 Rate Jumper

RATE is in minutes and is for controllers with either a Time Proportioning Output(s), current output, or electric actuator positioning outputs. Either .05, .1, .5 or 1 minute is selectable. Move jumper to the Off storage position for all other models. Jumper is located in the Off position when controller is shipped from the factory.

11.3 Cooling Limit Adjustment

The COOLING LIMIT Adjustment is located on the Output 2 Triac Switching Card A-11771-000-1. Adjustable from 0 to 100% ON time.

11.4 Current Card Action

The current card outputs are shipped with reverse action. To change to direct action, See Figure 11-2.

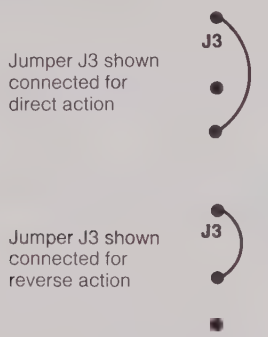


Figure 11-2. Changing Current Card Action from Reverse to Direct Action.

12. SETUP: OVERALL DESCRIPTION

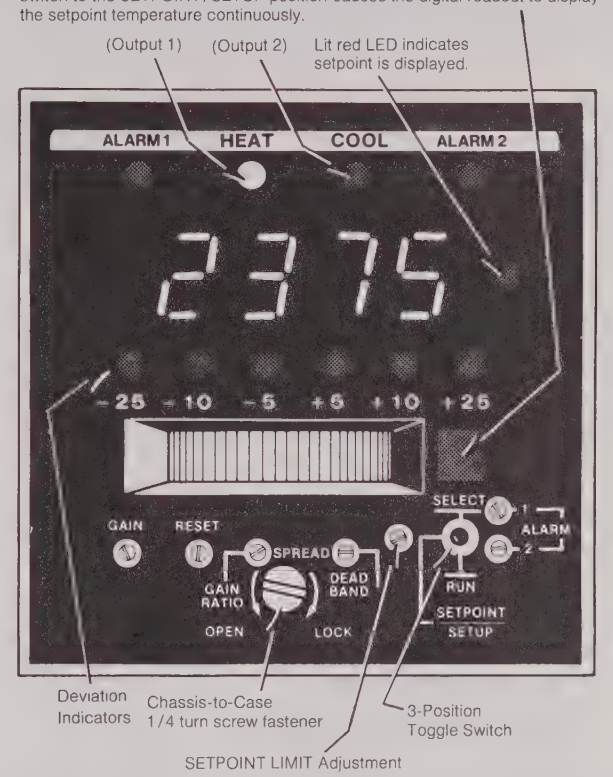
Table 12-1 on pages 16 and 17 summarizes the adjustments and jumpers on your model.

Most adjustments are under the front panel access door. Page 4 shows the styles of access doors.

Deviation Scale Operation

Process Temp. °F	Setpoint Temp. °F	LED Lighted	Range of Deviation °F
1475 or lower	1500	-25	-25 or lower
1476 to 1490	1500	-10	-10 to -24
1491 to 1495	1500	-5	-5 to -9
1496 to 1504	1500	None	-4 to +4
1505 to 1509	1500	+5	+5 to +9
1510 to 1524	1500	+10	+10 to +24
1525 or higher	1500	+25	+25 or higher

Setpoint Pushbutton: Pressing the Setpoint Pushbutton causes a momentary setpoint display when the toggle switch is in the RUN position. Moving the toggle switch to the SETPOINT/SETUP position causes the digital readout to display the setpoint temperature continuously.



The Setpoint Limit Adjustment is recessed under a hole covered with a plastic cap. The cap prevents accidental tampering with the setpoint limit. Do not lose the cap — replace it after any setpoint adjustment.

SETPOINT LIMIT Adjustment adjusts setpoint limits from top of temperature span (fully CCW) down to 1/4 of the way from the bottom of the span (fully CW).

Figure 13-1. Display Description

13. DISPLAYS DESCRIPTION

READOUTS

Control information is displayed by highly visible light emitting diodes.

Digital Display: A four digit LED (light emitting diode) readout displays Process, Setpoint, and Control Adjustment settings. The seven-segment, red LED's are 0.55 inches tall for good readability.

Deviation Scale: A horizontal array of six LED's displays the temperature difference between Process and Setpoint. When this deviation is less than ± 5 degrees, none of the LED's are lit. The deviation increments are labeled -25, -10, -5, +5, +10, and +25.

Heat Indicator: A red LED above the Digital Readout lights when Output 1 is energized. It flashes in proportion to the Demand signal (% output) if the time proportioning control mode is selected via the CYCLE TIME block jumper on the Display Driver Card.

If the On-Off control mode is selected, the HEAT LED is ON when Process Temperature is below Setpoint and switches Off at Setpoint. The LED will again switch ON when the Process Temperature drops 5 degrees below Setpoint. Actuator Controller HEAT Light lights to indicate CCW rotation.

Cool Indicator: This red LED above the Digital Readout lights when Output 2 is energized. It flashes to indicate cycling of either the triac or relay outputs. Current Output is not available for Output 2. Actuator Controller COOL LED lights to mark CW rotation.

Alarm 1 (LED) Indicator: A red LED above the Digital Readout lights to indicate Alarm 1 status. Normally, the LED lights when the alarm relay is energized. This action can be reversed by re-positioning a soldered jumper on the single alarm circuit card.

Alarm 2 (LED) Indicator: This red LED above the Digital Readout lights to indicate the Alarm 2 status.

On a Dual Alarm, the LED indicator for either Alarm 1 or Alarm 2 will light only when the alarm relay energizes.

SETPOINT INDICATOR

When the setpoint temperature is displayed, a red LED (located to the right of the Digital Readout) lights to remind the operator of the display status.

THERMOCOUPLE BREAK ACTION

Upscale is standard. Digital Readout will display "HI" if a thermocouple break occurs.

14. RANGE AND DISPLAY UNIT SELECTION

To verify range selection do as follows.

1. The range and display unit (°F or °C) is field selectable by block jumpers located on the Main Board.
2. Always verify range selection by checking the block jumper positions on the Main Circuit Board. Compare the status of your instrument with Figure 14-1 and Table 15-1 below. Record range and display unit (°F or °C) for future reference. The range and display unit are not labeled on the front artwork of the controller.

Table 15-1.

Range Code	TC	Range	Display Units	Block Jumper	Jumper Positions
4540	J	-100 to 1500	°F	1	B-6
4543	J	-100 to 800	°C	2	B-6 and A-°C
0031	K	0 to 2500	°F	1	B-4
4544	K	0 to 1350	°C	2	B-4 and A-°C
4541	R	0 to 3100	°F	1	B-10
4545	R	0 to 1700	°C	2	B-10 and A-°C
4542	S	0 to 3100	°F	None	----
4546	S	0 to 1700	°C	1	A-°C

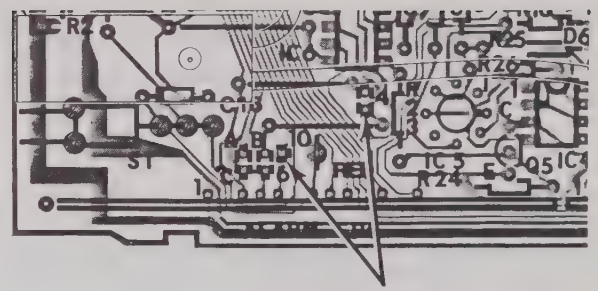
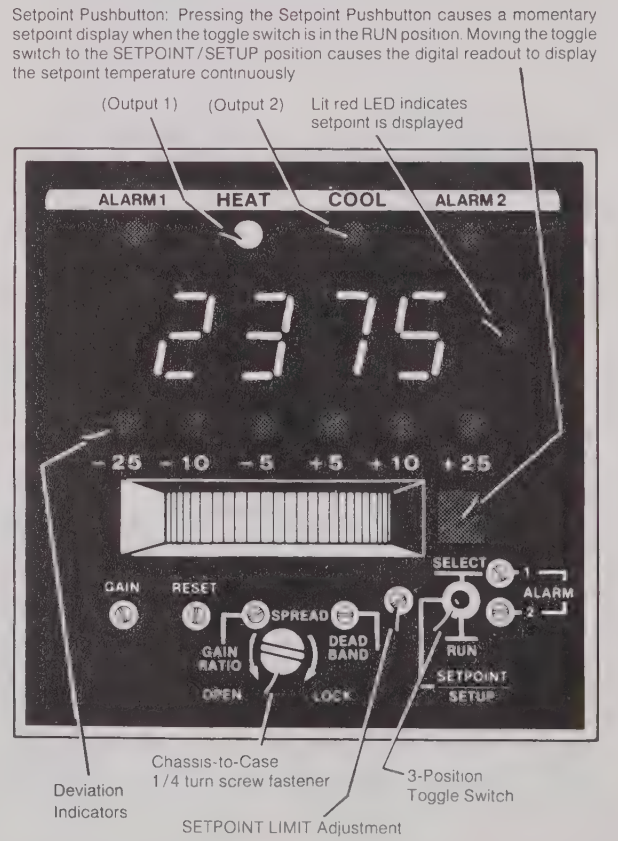


Figure 14-1. Block Jumpers on the Main Board A-12333.

14-1. BEFORE SETUP: PRELIMINARY OPERATION



The Setpoint Limit Adjustment is recessed under a hole covered with a plastic cap. The cap prevents accidental tampering with the setpoint limit. Do not lose the cap — replace it after any setpoint adjustment

SETPOINT LIMIT Adjustment adjusts setpoint limits from top of temperature span (fully CCW) down to 1/4 of the way from the bottom of the span (fully CW)

Figure 15-1. Control Adjustments Access Door and Pull-handle not shown

15.1 Selecting and Displaying a Control Adjustment

SELECT — SETPOINT/SETUP — RUN Toggle Switch

A three position toggle switch located under the access door is used to select an adjustment for display.

Changing the switch position will not interrupt control operation, allowing the operator to safely check any control adjustment.

Table 15-1. 3-Position Toggle Switch Functions

Switch Position	Function
SELECT	Momentary toggle position to advance to the desired control adjustment to display and adjust it.
SETPOINT/SETUP	Continuous display of either setpoint temperature or control adjustment valve during setup.
RUN	Process Temperature displayed.

3-Position Toggle Switch Proceed from top to bottom of Table 15-2 to go through the toggling sequence for the 3-Position Toggle Switch. The second column in the table shows the LED which lights to indicate which control adjustment is displayed for adjustment.

When the switch is first toggled to the momentary SELECT position, the value for GAIN is displayed on the digital readout and the -25 LED (marked -25) is lit on the scale. GAIN adjustment can then be made while observing the changing value on the digital readout.

Toggling the switch to the SELECT position again advances the display to the next control adjustment which is RESET. The LED (marked -10) lights to indicate that the RESET value is displayed and ready for adjustment.

The displayed parameter sequence continues as described in Table 15-2 except for Single Output models 58XA, where control adjustments for GAIN RATIO, DEADBAND, or SPREAD do not apply. For these models, the display advances directly to the ALARM 1 Trip Point after RESET.

15.2 Process Setpoint

Setpoint Pushbutton may be depressed to display Setpoint temperature on the digital readout. To identify that Setpoint is being displayed, the LED (located to the right of the digital readout) lights.

A Mechanical Lock on the Setpoint Dial prevents accidental change. Depressing the large square Setpoint Pushbutton releases the Setpoint Dial to allow adjustment.

Setpoint Can Be Changed by rotating the Setpoint Dial. Releasing the Setpoint Pushbutton engages the Mechanical Lock on the Setpoint Dial to prevent accidental Setpoint change.

Setpoint Display can be momentary or continuous. Pressing the Setpoint Pushbutton causes a momentary setpoint display when the toggle switch under the access door is in the RUN position. Moving the toggle switch to the SETPOINT/SETUP position causes the digital readout to display SETPOINT temperature continuously.

Setpoint Adjustment

1. Move the toggle switch, located under the access door, from RUN to the position labeled SETPOINT. In this position, SETPOINT Temperature is continuously displayed on the digital readout.

   The setpoint LED, located to the right of the digital readout, lights whenever the SETPOINT Temperature is displayed.

2. To change the SETPOINT Temperature, press and hold the Setpoint Pushbutton to release the mechanical lock and rotate the Setpoint Dial until the desired SETPOINT temperature is displayed.

3. When the toggle switch is in the RUN position and the Setpoint Pushbutton is released, the display indicates Process Temperature.

SELECT Toggling Sequence is described in Table 15-2. A Bar-Graph LED identifies which control adjustment is displayed for adjustment.

Table 15-2. Sequence and Control Adjustment Display for 3-Poisition.

Control Adjustment Displayed	Bar-graph LED Lit	Control Adjustment Range Displayed from CCW to CW
GAIN	-25	1 to 100
RESET	-10	0 to 6.0 Repeats per Minute
GAIN RATIO or SPREAD COARSE	-5	1:1 to 50:1 or Setpoint Temperature ±145°
DEADBAND OR SPREAD FINE	+5	0 to 20 or Setpoint Coarse ±7°
ALARM 1 Trip Point	+10	Process: 0 to 100% of Span Deviation: 0 to 500° from Setpoint Deviation Band: 0 to 500° around Setpoint.
ALARM 2 Trip Point	+25	

Note: If the toggle switch is placed in the RUN position at any time during setup, the next SELECT postion toggle will return the display to GAIN readout.

16. SETUP: ALL CONTROLLERS, FRONT PANEL SETPOINT LIMIT, GAIN, RESET, AND ALARMS ADJUSTMENTS

16.1 Setpoint Limit Adjustment

This is the unmarked adjustment to the right of the DEADBAND adjustment. A plug cap covers this adjustment to eliminate unauthorized changes. Replace the plug button after any adjustment. This adjustment limits the maximum setpoint of the range from the top of the purchased span (fully CW) down to 1/4 of the way from the bottom of the span (fully CCW).

For example, if the range of the instrument is 0 to 2500°F, the range can be adjusted from 0 to 625°F fully CCW to 0 to 2500°F fully CW.

Table 12-1. Summary of Adjustments

Model	Description
	ON-OFF Output
551A	Triac
552A	Relay
	Single Time Proportioning Output
555A	Triac
556A	Relay
	Single Current Output, Reverse Acting
557A	2-12 mA
558A	4-20 mA
	DUAL OUTPUT: ON-OFF Relay — Output 2
551B	On-Off Triac — Output 1
555B	Time Proportioning Triac — Output 1
557B	Current, 2-12 mA — Output 1
558B	Current, 4-20 mA — Output 1
	DUAL OUTPUT: Time Proportioning Triac — Outpu
555C	Time Proportioning Triac — Output 1
556C	Time Proportioning Relay — Output 1
557C	Current, 2-12 mA — Output 1
558C	Current, 4-20 mA — Output 1
5599	Electric Acutator Positioning***

X = Only on this model
* = Jumper located on Display Driver Card
** = Potentiometer located on Output 2 Card
*** = Deadband located on Actuator Positioning Controller Output Card

To adjust the setpoint limit to 0 to 2000°F, do the following:

1. Turn the Setpoint Dial fully CW (maximum setpoint).
2. Adjust the SETPOINT LIMIT Adjustment until 2000°F is displayed.
3. Adjust the Setpoint Dial to the desired setpoint.

16.2 Gain Adjustment

1. Adjust GAIN (factory set CCW for a wide Proportional Band), after the process stabilizes, by moving the toggle switch under the access door to the momentary SELECT position and releasing it to return to the center SETUP position.

   The digital readout displays the GAIN value (fully CCW is a GAIN of 1 and a proportional band of 100% of span) and the left-most LED (marked −25) will light.
2. Use a small screwdriver to rotate the GAIN potentiometer while observing the value for GAIN on the digital display.
3. After making a small change in GAIN, test the stability of control by simulating a Process upset. Change the SETPOINT forty (40) or fifty (50) degrees to simulate the Process upset.
4. Observe the Process response. If the control is stable, increase the GAIN potentiometer CW in small increments, until control becomes unstable. Then, decrease the GAIN slightly CCW.
5. Allow ample time for the controller to stabilize between adjustments.
6. Make changes in the SETPOINT, up and down alternately, to remain near the desired operating setpoint temperature.
7. When a stable value for GAIN is reached, record that setting for future reference.

16.3 Reset Adjustment

1. Integral action can now be introduced with the RESET potentiometer (factory set fully CCW, 0 repeats per minute).
2. Move the toggle switch under the access door to the momentary SELECT position and release it to return to the center SETUP position. This advances control adjustment status from GAIN to RESET.

   The LED (marked −10) lights to indicate that the display is indicating the RESET adjustment.
3. Use a small screwdriver to rotate the RESET potentiometer and change the Integral (RESET) action to reach stable control. RESET is adjustable from 0 to 6.00 repeats per minute.
4. When a stable value for RESET is reached, record that setting for future reference.

Dual Output Controllers Front Panel Adjustments			Single or Dual Output Controllers		GAIN, SETPOINT LIMIT, and RESET Adjustments	ALARM 1, ALARM 2 Adjustments
Marked DEADBAND	Marked GAIN RATIO	COOLING LIMIT**	CYCLE TIME Jumper*	RATE Jumper*		
					None	Either One Alarm or Two Alarm Adjustments are on all models with Alarms
					None	
					None	
					None	
					None	
			X	X	None	
			X	X	None	
					None	
					None	
				X	None	
				X	None	
SPREAD FINE	SPREAD COARSE				GAIN SETPOINT LIMIT, AND RESET are on all these models.	
			X Output 1			
				X Output 1		
				X		
DEADBAND	GAIN RATIO	X	X Both Outputs	X Both Outputs		
		X	X Both Outputs	X Both Outputs		
		X	Output 2 Only	X Both Outputs		
		X	Output 2 Only	X Both Outputs		
				X		

16.4 Alarms Adjustment

Alarm adjustment values can then be displayed on the digital readout by means of the SELECT, SETPOINT/SETUP, RUN toggle switch under the access door. The alarms are adjusted as follows:

Alarm 1

1. Move the toggle switch to the SETUP position and toggle it to the momentary SELECT position until the LED (marked +10) is lit. This verifies that the value for Alarm 1 is displayed.
2. Use a small screwdriver to rotate the Alarm 1 potentiometer while observing the alarm value on the digital display. Refer to the ALARM VALUES description below for the proper alarm mode and range of adjustment.

Alarm 2

1. For Alarm 2 on Dual Alarm models, move the toggle switch to the momentary SELECT position until the LED (marked +25) is lit. This verifies that the value for Alarm 2 is displayed.
2. Use a small screwdriver to rotate the Alarm 2 potentiometer while observing the alarm value on the digital display. Refer to the ALARM VALUES description below for the proper alarm mode and range of adjustment.

Alarm Values

Process Alarm: The value displayed is the Process temperature (displayed in degrees) where the alarm will trip. The range of adjustment is from 0 to 100% of span.

Deviation Alarm "+": The value displayed is the number of degrees above Setpoint that the alarm will trip. The range of adjustment is from 0 to 500° above Setpoint. Add this value to the Setpoint value to determine the actual Alarm Trip Point temperature.

Deviation Alarm "–": The value displayed is the number of degrees below Setpoint that the alarm will trip. The range of adjustment is from below Setpoint. Subtract this value from the Setpoint value to determine the actual Alarm Trip Point temperature.

Deviation Band Alarm: The value displayed is the number of degrees on each side (symmetrical) of the Setpoint that the alarm will trip. The range of adjustment is from 0 to 500° symmetrical about the Setpoint. Add and Subtract this value to the Setpoint value to determine the actual Alarm Trip Point temperatures.

17. SETUP: DUAL OUTPUT CONTROLLERS, FRONT PANEL SPREAD, DEADBAND, AND GAIN RATIO ADJUSTMENTS.

Also Electric Actuator Positioning Controller Deadband.

17.1 Spread Coarse Adjustment

See Table 12-1. and Figure 17-1. This adjustment is only active on controllers with the ON-OFF Relay Switching on Output 2.

The SPREAD COARSE Adjustment is marked GAIN RATIO on the front panel.

1. Use SPREAD COARSE (factory set for zero Spread) to separate Output switching action.

   Output 1: Energized at setpoint temperature.

   Output 2: Switches at SPREAD temperature.
2. To determine the Output separation, connect a millivolt source to the input terminals to simulate a Process Signal.

   A change in setpoint moves the switching points of both outputs equally. Therefore, SPREAD may be established with respect to any setpoint temperature. Separation between outputs will not change until SPREAD is readjusted.
3. When adjusting SPREAD, the value displayed on the Digital Readout is the process temperature where the Output 2 Relay will de-energize. The temperature where the relay will energize is nominally 5 degrees above this point and must be considered for precise setup and response. This 5 degree hysteresis avoids undesirable fast cycling of the Output 2 Relay and load.
4. Controllers are shipped factory set for zero Spread between Outputs so that Output 2 energizes when the process temperature exceeds SETPOINT.
5. For optimum control of temperature, a cooling Fan on Output 2 can be activated either above or below setpoint (Output 1). To set the switching point for Output 2, adjust SPREAD as follows:
6. First, determine a setpoint (0% ON) for Output 1. Move the toggle switch under the access door to the RUN position and then back to the SETPOINT/SETUP center position. Record the setpoint temperature displayed on the Digital Display.
7. Press the Setpoint Pushbutton on the Front panel to display Setpoint. Adjust the value displayed by rotating the Setpoint Dial or by changing the input millivolt source. Record the selected setpoint temperature.
8. Add or subtract the degrees of switching separation desired (between Output 1 and Output 2) to the setpoint recorded. This is the temperature where the Output 2 Relay will de-energize and the value to set when making the SPREAD adjustment.
9. Move the toggle switch repeatedly to the momentary SELECT position to advance control adjustment status to the SPREAD COARSE adjustment.

   The LED (marked −5) lights to verify that SPREAD COARSE is displayed.
10. With a small screwdriver, rotate the SPREAD COARSE potentiometer to display the desired temperature for the Output 2 Relay to de-energize. The relay will ENERGIZE nominally 5 degrees above this point. The LED labeled COOL lights only when the Output 2 Relay is ENERGIZED.

    Example: If SPREAD COARSE was set to 322 and the desired value is 320, use SPREAD FINE to accurately adjust to 320.

17.2 Spread Fine Adjustment

See Table 12-1. and Figure 17-1. This Adjustment is only active on controllers with ON-OFF Relay Switching on Output 2. The SPREAD FINE Adjustment is marked DEADBAND on the front panel.

1. SPREAD FINE is a high resolution adjustment but has a narrow range (±6 degrees); therefore, it may be necessary to readjust SPREAD COARSE to reach the desired setting with SPREAD FIND.
2. With the SPREAD FINE potentiometer in its center position, the value displayed for SPREAD COARSE must be within 6 degrees of the precise temperature desired to de-energize the Output 2 Relay.
3. Move the toggle switch located under the access door to the momentary SELECT position and release it to return to the center SETUP position. This advances control adjustment status from SPREAD COARSE to SPREAD FINE.

   The LED (marked +5) lights to indicate that the SPREAD FINE adjustment is displayed.

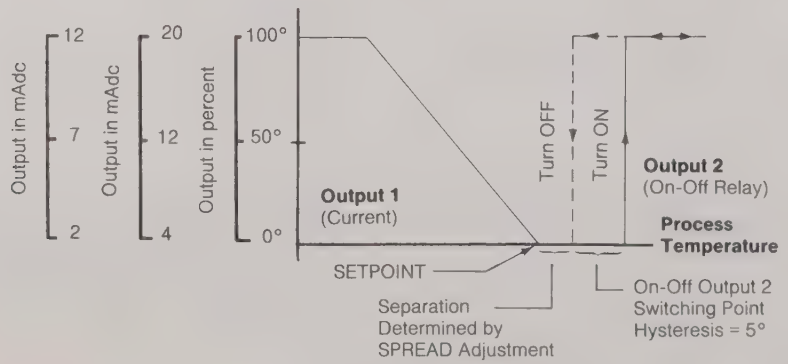


Figure 17-1. Dual Output Switching and SPREAD Adjustment

4. With a small screwdriver, rotate the SPREAD FINE potentiometer until the display indicates the precise temperature to de-energize the OUtput 2 Relay. The difference between this temperature and the controller's SETPOINT is the degrees of SPREAD or separation between Output 1 and Output 2.

   Example: To energize the Output 2 Relay 25 degrees above a setpoint of 300 degrees, the value to set SPREAD is 320.

17.3 Deadband Adjustment

See Table 12-1. This Adjustment is only active on controllers with a Time Proportioning Triac on Output 2.

1. The DEADBAND control adjustment (factory set CCW, 0 degrees) separates the action of Output 1 and Output 2 on a process.
2. Some loads function adibatically and energy can be conserved by adding a small amount of DEADBAND to the control system.
3. Adjust DEADBAND after the process has stabilized. Move the toggle switch located under the access door to the momentary SELECT position and release it to return to the center SETUP position. This advances control adjustment status from GAIN RATIO to DEADBAND.

   The LED (marked +5) lights to indicate that the display is the control adjustment DEADBAND in degrees.
4. If the range code selected is degrees F, the DEADBAND value displayed is in degrees F. If the range code selected is degrees C, the DEADBAND value displayed is in degrees C.

17.4 Gain Ratio Adjustment

See Table 12-1. This adjustment is only active on controllers with a Time Proportioning Triac on Output 2.

1. The GAIN RATIO control adjustment (factory set at 10:1) compensates for differences in the effect that heating and cooling have on a process. Generally, cooling requires much less gain than heating, allowing the operator to reduce the GAIN (increase the proportional band) of the cooling output without affecting the GAIN (proportional band) of the heating output.

$$\text{GAIN RATIO} = \frac{\text{HEATING GAIN}}{\text{COOLING GAIN}}$$

2. If the process temperature is drastically reduced when cooling occurs, a GAIN RATIO adjustment is required. Adjust GAIN RATIO after the process stabilizes.
3. Move the toggle switch located under the access door to the momentary SELECT position and release it to return to the center SETUP position. This will advance control adjustment status from RESET to GAIN RATIO.

   The LED (marked −5) lights to verify that the display indicates the GAIN RATIO adjustment.
4. Use a small screwdriver to rotate the GAIN RATIO potentiometer while observing the value for GAIN RATIO on the digital display. The range of the GAIN RATIO adjustment is 1:1 fully CCW to 50:1 fully CW. The display indicates 1 to 50.
5. Make changes in GAIN RATIO in very small increments. The operator must allow ample time for the controller to stabilize between adjustments.
6. When a stable value for GAIN RATIO is reached, record that setting for future reference.

17.5 Electric Actuator Positioning Controllers

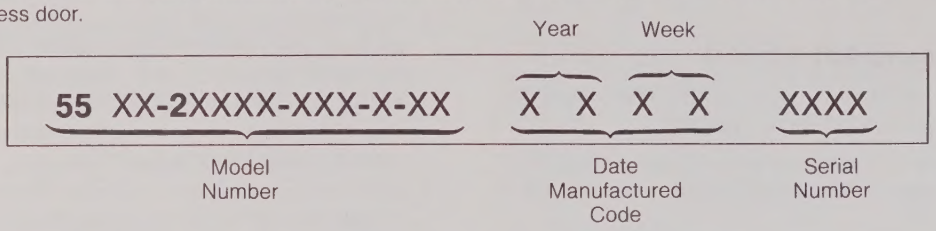
There are two "Output" Cards for the Actuator Positioning Controllers. DEADBAND is a potentiometer on the output card. DEADBAND is adjustable from 3 to 8% of full actuator travel.

Initially, set DEADBAND at 3% (Potentiometer turned fully CCW). There will probably be cycling. Increase the deadband setting until the cycling stops.

18. SERVICE

Service Information Schematics, Card Parts Location, and Parts Lists are in 1252 IN501 which is available from the Industrial Instruments Division of Barber-Colman Company.

The Model Number of the Controller, the Date Manufactured Code, and the Serial Number of the Controller are all on the inside of the front panel access door.



For example, if the Date Manufactured Code is 3 8 1 8 , the Controller was manufactured in the 18th week of 1983.

When making any service inquiries, always have available the date manufactured and the serial number of the malfunctioning instrument.

WARRANTY

This product is warranted according to the General Warranty Statement that is part of the Terms and Conditions of Sale of the Industrial Instruments Division, Barber-Colman Company.

The warranty for this product is effective for TWO YEARS AFTER SHIPMENT from Barber-Colman Company.

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Barber-Colman Company
INDUSTRIAL INSTRUMENTS DIVISION

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